

PATENT SPECIFICATION

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NO DRAWINGS.

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COMPLETE SPECIFICATION.

Method of Producing Refractory Moulds for Precision Casting.

We, SOCIETE DES FORGES ET ATELIERS DU CREUSOT, a French Corporate Body of 15 rue Pasquier, PARIS 8°, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a method of producing refractory moulds for precision casting of metals, such as steels, ferrous alloys, refractory alloys, copper alloys and light alloys.

Conventional methods of preparing refractory moulds comprise the insertion of a refractory lining into the space between the fusible pattern, which is generally of wax, and a metal chamber so disposed as to form a box around the fusible pattern. This lining contains a binder, such as soluble alkaline silicate, organic silicate, colloidal silica, a refractory cement, or a refractory phosphate, in solution. In addition the lining contains a powdered natural or synthetic refractory material, such as silica, sillimanite, fire-clay or zircon, as filler.

After the lining has set in air, the wax is eliminated, and the mould is then fired at a temperature of about 800 to 1000°C which causes it to harden considerably, so that it is then capable of receiving the molten metal.

This conventional method has various disadvantages in certain cases. Firstly, the mould has a high weight and the volume of the parts that can be cast is limited, and secondly the consumption of refractory material is considerable. Furthermore the very slow cooling due to the thickness of the mould sometimes results in surface decarburisation of the castings and a coarse crystallisation of the metal.

We have now developed a method for the

production of an improved refractory mould for precision casting.

According to the present invention we provide a method of producing refractory moulds for precision casting which includes the steps of applying, in sequence, a contact coating, a primary coating and at least one reinforcing coating to a wax pattern or group of interconnected patterns, each coating being applied in the form of an opaque slip which includes a siliceous binder and a powdered refractory material, each slip being thicker than the slip used for the previous coating and each coating being sprinkled with a granular refractory material before the coating is dry whereby the grains are anchored between two successive coatings, the refractory material sprinkled on the contact coating having a grain size of from 0.1 to 0.3 mm. Thereafter the mould is dried, the wax pattern is melted out and the mould is fired in the usual way.

The application of the slip may be made either by immersion or by coating with a brush.

The composition of the slip is such that after each coating the deposited slip sets in air, i.e. a coating forms which is sufficiently firm to withstand handling and the next coatings. The composition is also such that the coating is capable of assuming considerable hardness by firing at a temperature of 700° C and above.

It is advantageous to vary the grain size of the granular refractory material according to the coating on which it is sprinkled, the grain size being progressively increased from coating to coating. The sprinkling operation ensures that the required thickness of the mould is obtained more rapidly than if the mould were made of the slip coatings alone and also renders the coatings uniform. It also enables slip coatings of very

different compositions to be superimposed without danger of the coatings disintegrating during firing or casting of the metal. In addition, it gives the mould good gas permeability which is required during casting of the metal. The sprinkling must be effected so that the granular refractory material is anchored to the slip coating and projects beyond said coating to serve as a key for the next slip coating.

To obtain the surface fineness and cleanliness required for precision casting, the refractory constituent in direct contact with the metal to be cast must be selected according to the characteristics of the metal so as to avoid any surface reactions before the metal has set in the mould.

Thick slips are preferably used, thus enabling the number of coatings required to be reduced and the rapidity of production

to be increased. Constituents suitable for the slips include, for example, colloidal silica or an ethyl silicate as a binder, whilst the refractory material may be, for example, natural crystalline silica (quartz), pure fused silica, alumina, zircon (zirconium silicate), zirconium (zirconium oxide), sillimanite, or ground burnt clay having a high alumina content. A preferred grain size for the refractory material of the contact coating and the primary coating is 75 microns and the reinforcing coating(s) preferably contain one or more refractory materials having a grain size of 75 microns and at least one refractory material which will pass a screen with a mesh opening of 0.5 mm.

Examples of the composition of the slips used in a preferred form of the invention are given below by way of illustration.

40	<i>Example of binder</i>	<i>Solution 1</i>	<i>Solution 2</i>
	Concentration of colloidal silica solution containing 30% by weight of silica	1000 c.c.	750 c.c.
	Water		250 c.c.
45	Anti-drying agent, such as glycerin	2 c.c.	
	One or more wetting agents ...	3 c.c.	3 c.c.
	One or more anti-foaming agents	7 c.c.	7 c.c.

Example of slip for contact coating:

50	Solution 1 Powdered fused silica passing a 200 screen (grain size approximately 75 microns)	1000 c.c. 1 to 1.5 kg.
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The pattern is degreased before immersion. Immediately after the pattern has been immersed into this slip, the slip coating formed is sprinkled with fused silica having a grain size of from 0.1 to 0.3 mm.

Example of slip for primary coating:

60	This coating has to be harder than the contact coating. Solution 2 Zircon powder passing a 200 screen (grain size about 75 microns)	1000 c.c. 2.3 to 3 kg.
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This slip unites perfectly with the preceding coating and is anchored thereon by the sprinkling of grains which was applied thereto.

Sillimanite of a grain size of 0.2 to 0.6 mm. is sprinkled on the primary coating

and as in the previous case gives good keying to the next coating.

Example of slip for the reinforcing coatings:

75	Solution 2 Zircon powder Sillimanite powder Pulverised sillimanite passing through a 0.5 mm opening screen	1000 c.c. 0.600 kg. 0.200 kg. 3.200 kg.
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Sillimanite or fireclay of a grain size of 0.2 to 0.6 mm, for example, is sprinkled on each coating having the above composition so as to form successive reinforcing coatings. In some cases a larger grain size may be used for sprinkling, for example 0.3 to 1 mm, depending on the type of casting; a larger grain size enables the required thickness of the multi-layer mould to be attained more rapidly.

The thickness, and the number of coatings required to reach this thickness, naturally depend on the type of casting and the shape of the pattern or group of patterns. For example, a total of 6 coatings is sufficient for moulds intended to receive 4 kg. of molten metal.

After the various coatings have been dried, the wax is eliminated by known processes, such as heating or treatment with steam or trichlorethylene.

5 With the moulds obtained by the invention it is possible for the mould still containing the fusible pattern to be introduced directly into the firing kiln, since the multi-layer formation of the mould is not sensitive to thermal shock. Firing is suitably carried out at a temperature of from 700 to 10 950°C for about one hour.

If the kiln base has an outlet for the wax, a substantial part of the latter can be recovered.

15 After firing, the moulds according to the invention perfectly withstand normal casting conditions whether on a swinging furnace on which the mould is mechanically locked, 20 or gravity casting and have an internal grain fineness which gives the castings produced a good surface quality.

WHAT WE CLAIM IS:—

25 1. A method of producing refractory moulds for precision casting which includes the steps of applying, in sequence, a contact coating, a primary coating and at least one reinforcing coating to a wax pattern or group of interconnected patterns, each 30 coating being applied in the form of an opaque slip which includes a siliceous binder and a powdered refractory material, each slip being thicker than the slip used for the previous coating and each coating 35 being sprinkled with a granular refractory material before the coating is dry whereby the grains are anchored between two successive coatings, the refractory material sprinkled on the contact coatings having a 40 grain size of from 0.1 to 0.3 mm.

2. A method according to claim 1, in which the pattern or group of patterns is degreased before the application of the contact coating.

45 3. A method according to claim 1 or 2, in which the slip for the contact coating contains an anti-drying agent and at least one wetting and anti-foaming agent.

4. A method according to any of claims 1 to 3, in which the siliceous binder is a 50 30% by weight colloidal silica solution.

5. A method according to any of claims 1 to 4, in which the grain size of the powdered refractory material in the contact coating is 75 microns. 55

6. A method according to any of claims 1 to 5, in which the slip for the primary coating contains a siliceous binder in a proportion, by weight, less than that of the contact coating slip and at least one wetting and anti-foaming agent. 60

7. A method according to any of claims 1 to 6, in which the grain size of the powdered refractory material in the primary coating slip is 75 microns and the proportion thereof is 2—3 times greater than in the contact coating slip. 65

8. A method according to any of claims 1 to 7, in which the primary coating is sprinkled with a granular refractory material having a grain size about twice that of the material used for sprinkling the contact coating. 70

9. A method according to any of claims 1 to 8, in which the reinforcing coating slip contains one or more refractory materials having a grain size of 75 microns and at least one pulverised refractory material which will pass a screen with a mesh aperture of 0.5 mm. 75

10. A method according to any of claims 1 to 9, in which each reinforcing coating is sprinkled with a granular refractory material having a grain size in the range of 0.2 to 1 mm. 80

11. A method of producing refractory moulds for precision casting substantially as herein described. 85

12. A refractory mould when produced by the method claimed in any of claims 1 to 11. 90

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